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Resilient Health System and Hospital Disaster Planning

Stephen C. Morris

Abstract

Disaster planning is integral component of hospital operations and management, and hospital resiliency is critical to society and health systems following a disaster. Additionally, hospitals, like all public institutions have significant risk of security incidents including terrorism, isolated and mass violence, social unrest, theft and vandalism, natural and human made disasters. Security and disaster planning are cumbersome, expensive and easy to deprioritize. When a hospital disaster is defined as anything that exceeds the limits of the facility to function at baseline, disasters and security incidents are intertwined: disasters create security problems and vice-versa. Hospital resiliency to disasters and security incidents stems from a systems-based approach, departmental and administrative participation, financial investment and flexibility. Significant best practices and lessons learned exist regarding disaster and security planning and ignorance or lack of adoption is tantamount to dereliction of duty on the part of responsible entities. This chapter consists of a review of the concepts of hospital disaster and security planning, response and recovery, as well as hospital specific disaster and security threats (risk) and their associated mitigations strategies. Risks will be presented follow a hazard vulnerability analysis (HVA), a common framework in emergency management, disaster planning and disaster medicine. As such, each element of risk is defined in terms of likelihood and impact of an event. Concepts of disaster medicine that are also addressed, as are administrative concerns, these elements are designed to be applicable to non-experts with an emphasis on cross disciplinary understanding. Additionally, elements are presented using incident and hospital incident command terminology and those not familiar should learn these concepts though free online training on the incident command system provided by several sources including The United States Federal Emergency Management Agency (FEMA), prior to reading.

Keywords: hospital security, disaster management, disaster medicine, disaster preparedness

1. Introduction

Disaster defined. A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts. -United Nations international strategy for disaster reduction (UNISDR).

Security events involving healthcare are timeless. Examples of security threats include families seeking retribution for perceived substandard care and healthcare facilities seen as military targets during times of conflict, despite universal agreement on medical neutrality [1]. Terrorism and acts of violence against healthcare workers and healthcare institutions are common enough to have become a field of study. There is also some evidence that the trend is growing, and there are many efforts, globally and locally to address the problem [2]. With violence all too common, it is no coincidence that government, policy and security institutions focus much attention on healthcare.

Disasters, from natural and human created events, are defined by the disruption of normal functioning. When the disaster affects multiple social institutions, healthcare's role in society often expands. In such events, for example, hospitals function beyond the provision of healthcare: a refuge for those in need, a gateway to social services, a bellwether for societal wellbeing, a bastion of hope and communal security in the face of disruption. As such the effect of disasters and security incidents on hospitals has an additive physical and psychological effect on the population. From a practical standpoint, the populations access to health services are interrupted or they may choose to avoid care. Additionally, they may have an inherent sense of insecurity as a major and essential public entity has been attacked or disturbed. The resiliency of hospitals, in the face of major disaster and security events, is paramount to social functioning at many levels and as such is a major concern for public officials and citizens through society.

Hospital security has many elements consistent with security of other institutions and organizations as well as many unique areas of vulnerability. Common security elements include basic building security, employment security, asset and material security, crowd and social unrest security, basic disaster specific security and basic IT security. These elements are addressed largely commiserate with standard practices for public institutions and will not be addressed here. Unique security vulnerabilities of hospitals are too many to name and addressing them all is beyond the scope of this text. Additionally, very specific hospital vulnerabilities such as medical waste, unaccompanied minors, and radiation security among others will not be addressed. Major unique vulnerabilities of hospitals largely stem from their reliance on other public institutions, such as governance and businesses, and the central role they play in society.

2. Emergency management, the disaster cycle and a healthcare perspective on security

2.1 Emergency management and disaster medicine

Disaster medicine and emergency management are two separate fields with overlapping areas of influence, like Venn diagrams with a large portion of common space. Therefore, it is critical that one understand the basic principles of emergency management as it relates to healthcare and hospital preparedness and response. The field of emergency management is premised on several paradigms: disasters are predictable, the disaster cycle, command and control and an all hazards approach.

2.2 Disasters are predictable

The idea of disasters being predictable is confounding to the lay public. Taking time to understand that most disasters are predicable with regards to their occurrence, impact and recovery is paramount to appropriate planning, response and

recovery. Furthermore, identifying what element of disaster are not predictable also allows for appropriate planning and should be acknowledged.

Examples of disaster Predictability	Examples of disaster elements that are unpredictable:
Hurricanes will affect the Caribbean between July and October	Timing of events.
Structurally unsound buildings will be damaged in an earthquake	Terrorist activities.
Social unrest will increase healthcare usage and burden of disease.	Storm trajectory, intensity and impact
Post disaster communal living conditions result in increased risk of communicable disease.	Earthquake timing, intensity and effect.

2.3 The disaster cycle

Together with the disasters themselves, institutions and societal response to disasters is predicable. This predictability has two patterns: the disaster cycle, and the social perception of disasters.

The disaster cycle refers to a pattern of institutional behavior surrounding disasters [3]. Since this is a cycle, one must appreciate the continuum and the interconnectedness of the elements. While the terms used change, the basic concepts of event, movement back to normal function, analysis of the event, mitigation, and preparedness remain the same through the fields of disaster medicine and disaster management.



2.3.1 Disaster response

The most publicly visible part of the cycle, the response phase, attempts to control the chaos of the acute period immediately following a disaster event. An event that overwhelms the health system, the definition of a disaster, necessitates adaption of the health system. From a hospital and health systems standpoint, this usually entails attempts to maintain the standard of care, provide for disaster victims and chronic illnesses, and support the greater community. The response period is undefined- from hours in the case of a mass casualty incident to years in the setting of armed conflict or humanitarian crisis.

2.3.2 Recovery

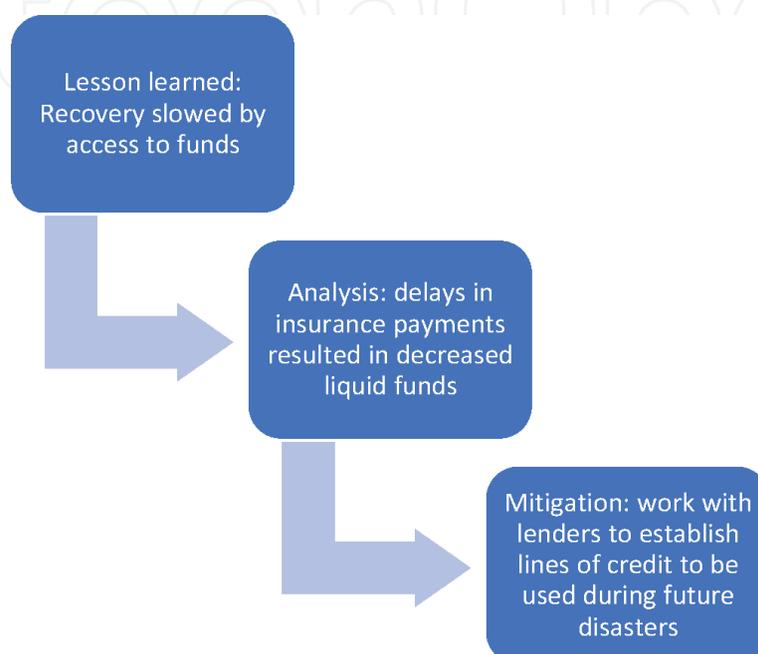
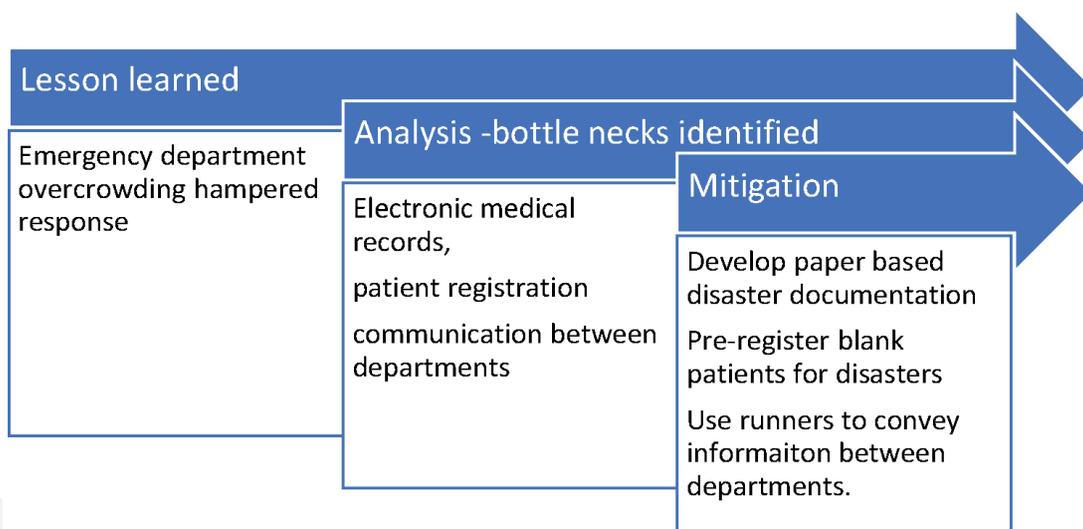
This phase of the disaster cycle is the period taken from the end of the disaster response phase, as defined by stabilizing of the situation, to the return of normal function. From a health systems standpoint, restoration of all services, provision of normal care including elective care, financial and administrative normalization are all goals of the recover period.

2.3.3 Process evaluation

Often left out of the disaster cycle is the appreciation of the interpretation of actions during the disaster response and recovery periods. It is from this analysis, that the lessons learned from the response and recovery are adapted into the foundations of mitigation and preparedness. Without establishing an understanding of systemic successes and failure, mistakes will be repeated.

2.3.4 Mitigation

Mitigation is the implementation of changes in systemic function based on analysis of lessons learned. Structural, strategic, and operational changes to the system seek to ensure more robust response and faster recovery in future events.



Examples of mitigation techniques:
Structural: building retro-fitting,
Human resources- reserve staffing
Material resources- stockpiling
Financial- lines of credit
Communication- use of radios, satellite phones
Administrative- established standard operating procedures and simplified disaster processes.

2.3.5 Preparedness

Preparedness represents the greatest period of the cycle longitudinally. Developing institutional plans, hazard vulnerability analysis with associated changes to plans, training, and licensing requirements all play key roles in the preparedness phase of the cycle. Additionally, given staff turnover, loss of institutional knowledge necessitates constant need for education.

3. Disaster medicine overview

3.1 Disaster medicine as a field

'a discipline resulting from the marriage of emergency medicine and disaster management'

- Gregory R. Ciottono, *Disaster Medicine 2nd Edition* [4]

Disaster medicine as a field represents all the components of possible disasters. It is a clinical subspecialty encompassing a combination of medical aspects of care in disasters and elements of other non-medical fields [5]. Main topics of import are the crossover of emergency medical care and emergency management, health systems response to disasters, response structure from local to international, the concept of surge, and the pathology and treatment of individuals and populations during general and specific disasters. From a hospital and healthcare perspective, disaster medicine is most critical in the response, recovery and preparedness phases of the disaster cycle. Adjusting the system and provision of care during the surge of an event, continuing patient care, adapting to changes in the complex systems required in the provision of care, as well as working with the response organizations, are all concepts and practices within disaster medicine. In addition, the recovery of normal operations requires thoughtful and dedicated processes also within the fundamentals of disaster medicine. Lastly, the field of disaster medicine is fluid, requiring adaption to new threats as well as adoption of new understandings and best practices [6].

3.2 Anticipated pathology

The pathology of disaster events ranges from worsening of chronic disease, to trauma, to infectious diseases to event specific disease such as radiation sickness.

Examples of disaster related clinical pathology, its cause and its effect on hospital care.

- Trauma- any physical disruption, such as an act of violence, accidents, storms, earthquake all will increase trauma needs, often overwhelming hospitals.

- Infectious disease- a disaster itself, such as in an epidemic, or more commonly this is a result of the social disruption associated with the disaster. Increased rates of infections with displaced populations, loss of access to clean water or immunocompromise are all expected events. Community spread infection can overwhelm health systems.
- Disruption in chronic care- inability to access or provide care at the level of the community is an expectation in any major disaster. Interruptions in chronic care lead to complications and resultant accommodation by acute care hospitals.
- Psychological disease- sub-acute, acute, and chronic physiological consequences are all expected following a disaster event, as is worsening of baseline psychiatric disease. These patients can become high utilizers of health care services both primarily for the psychological needs and secondarily, its associated social, behavioral and somatic consequences.

3.3 Specialized needs

Some disaster events require specific training and specialist clinical care. Examples of these and associated specialized care needs are:

Radiologic emergencies

Toxic exposures

Bioterrorism

4. Elements of hospital function affected by disasters and security incidents

4.1 Reliance on the public and private sector

Healthcare delivery is contingent on many elements of normal social functioning. When a disaster disrupts government services, the private sector and the environment, hospital systems will have to adapt to continue with their mission.

Examples of healthcare's reliance on other parts of society:

Material resources from the private sector, From pharmaceuticals to gloves, hospitals need inputs from the private sector. This can be mitigated somewhat through stockpiling of supplies, however the practice of stockpiling is no longer a feasible model for many if not most healthcare institutions [7]. Some government programs may provide safety nets for supplies such as the strategic national stockpile in the United States.

Government services: Healthcare workers take the bus to work, they need their children to be in school in order to go to work, hospitals require police protection, waste services and utilities; some or all of which may be disrupted in a disaster.

4.2 Facilities

Any disaster event that causes physical damage to the hospital or healthcare facility will likely affect its ability to provide care. Examples include the obvious such as earthquakes and storms but also acts of violence and vandalism.

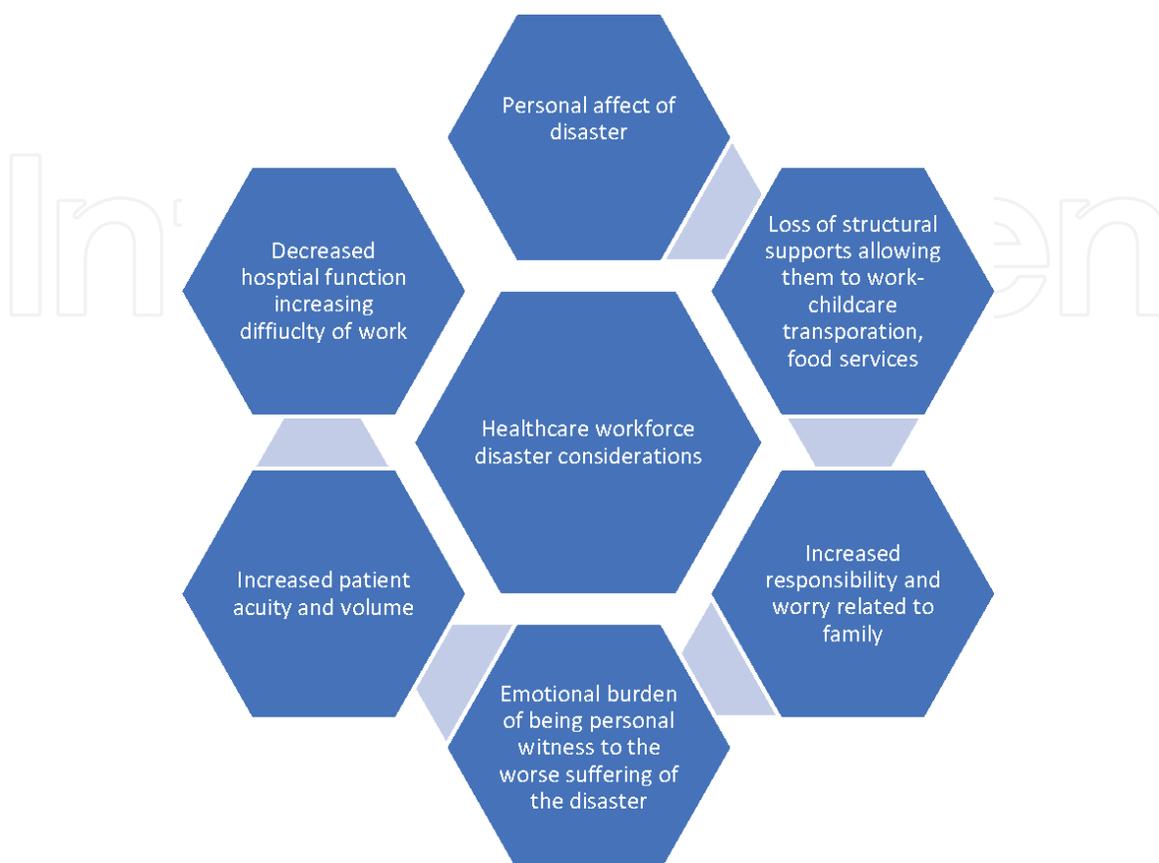
5. Healthcare workforce considerations

A major consideration with regards to health system functioning in a disaster, is that the healthcare workforce is affected by the disaster as much as the rest of society. The difference is that those in healthcare must still work when others are able to recover, and they share the emotional burden of others, bearing witness to their suffering. This can have a profound effect on wellbeing and efficacy in providing care. Worrying about loved ones while responding to a disaster event may have considerable consequences [8]. It is reasonable also to assume that despite their commitment and sense of duty to society, healthcare workers in a disaster who find themselves in the difficult situation of responding to their work or ensuring the safety and well being of their families are going to chose the latter.

5.1 Introduction

Functionality of the healthcare workforce in a disaster is a major consideration during all phases of the disaster cycle.

Few, if any, parts of society are going bear the burden of disasters more than healthcare workers and their families. Already dedicated to the wellbeing of the population, altruistic and hardworking, healthcare workers will be subject to conflicting responsibilities and seemingly insurmountable pressure. This untenable situation comes from three distinct consequences of the disaster. Increased workload, in the form of volume and acuity, emotional burden of being face to face with the tragedy of the disaster, familial responsibilities with less support than the rest of society, as they are still required to come to work. Additionally, as their work environment is also disrupted- for example supply shortages. Thus, their job is inherently more difficult. Hospital workers face even greater responsibilities with disruption of outpatient healthcare as these patients normally seen in clinics must now get their care in the hospital.



5.2 Healthcare workers disaster concerns

1. Healthcare workers are personally affected by the disaster the same as other members of society. Emotional distress, loss of housing, material resources, and health concerns. Death, injury, and illness of family without the ability to respond can be devastating.
2. Hospital function- despite the affects of structural destruction, materials shortage and increased patient volume, to name few pressures, healthcare workers at hospitals are expected to be present and preform.
3. Greater affects of social disruption- Healthcare workers rely on social services to support their work. Public transportation, elder and pet care, and childcare in the form of schools and after school activities. When these are disrupted the abilities healthcare workers on a practical and logisitional are diminished.
4. Healthcare workers have to preform major clinical problems in disasters: increased patient burden and acuity form the disaster itself, including those suffering from psychological affects and needing access to social services. Need to accommodate those who are unable to access care for acute and chronic health needs from disruption of outpatient healthcare, no changes in (non-disaster), healthcare needs of the their community.
5. Bearing witness to the worst of the suffering can have short and long term consequences on healthcare workers mental health [9].

5.3 Healthcare workforce resiliency

Maximizing healthcare worker performance in a disaster represents one of the greatest opportunities for disaster response and recovery. Some practical measures supporting healthcare workers include:

5.3.1 Healthcare worker family and household planning

Workers at all levels must have household planning that allows them to respond to work knowing that their family is safe and cared for. Any question family safety may result in failure to be present at work and/or suboptimal work performance.

Healthcare workers household safety plans should include:

- Household evacuation plans
- Agreements with family and friends to provide pet, child and elderly care.
- Two weeks of stocked material resources (food, medicine, comfort items)
- Backup utilities, communications and shelter plans.

5.3.2 Mutual aid agreements and health system collaboration for increased workforce resillancy

Establishing relationships with other healthcare institutions, with prearranged commitments of support can be crucial to an overwhelmed system.

Licensure planning allows for outside healthcare workers to provide care and support in a rapid manner. This involves rapid licensure and credentialing of out of system and/or out of the state or country healthcare workers.

5.4 Workforce wellbeing

Supporting workers wellbeing will increase efficacy and longevity. Examples of minimum support that should be planned for include:

- Private personal areas
- Food and hygiene
- Personal medicines,
- Scheduling to support rest and recovery
- Means for outside communication
- Structured and unstructured support of teambuilding and health before during and after a disaster

5.5 Labor unrest

A special disaster exists regarding healthcare workers and healthcare related labor disputes. These events can represent healthcare disasters in themselves and must be planned for accordingly. Hospital resiliency during these challenging situation can occur only with extensive management, collaboration and placing patient wellbeing before other priorities. Given the ethical challenges these situations represent all levels of the workforce maybe greatly affected [10].

6. Specific disaster and security considerations

6.1 Hazard vulnerability analysis

The all hazards approach means that planning can be adapted to any situation, but understanding the likelihood of occurrence and impact of specific disasters is paramount to good preparedness. Disaster planners use a hazard vulnerability analysis to quantify potential disaster events to their institution. This matrix uses a combination of the likelihood of an event will occur and severity of impact of the event to create a visual risk of disasters to the institution.

Example of a Hospital Hazard Vulnerability Matrix.

Low	Likelihood of occurrence	High
Low		Wind Storm
Impact to institutional function		Supply chain disruption
		Plane crash
	Power Outage	Multivehicle automotive crash
		Snow Strom
High	Earthquake	

6.2 Isolated violence

Acts of violence against healthcare workers, in or around healthcare institutions are common enough to have resulted in public outcry and public indifference. These events can have devastating effects on the individuals and institutions involved [11]. Promoting a culture of security including safety training (example active shooter training), freedom to disclose security concerns, engagement of all staff members in security planning and a weapons free environment all represent resiliency techniques [12].

6.3 Social unrest

This is an underestimated disaster with regards to its affect on healthcare. Social unrest from collective violence to political discord affect the mental and physical well being of the population and thus effect healthcare. General disaster planning should be sufficient, but messaging and communication to healthcare workers and the general population take on greater importance. The establishment and communication of the healthcare institutions as non-partisan and objective regarding the social unrest itself is paramount to continued function. Rumors increase anxiety and effect patients and clinicians alike and mis-information will fill any void in understanding. Communication of ability to provide care and overall function of healthcare delivery maybe a reassuring element in a time of crisis. Communication re-enforcing the positive public perception of healthcare as a benevolent social institution may also help health-care delivery.

6.4 Inclement weather

With some notable exceptions (major storms), a major disruption in standards of care secondary to inclement weather represents a failure of planning and preparation. Preparing for events or seasons with enhanced materials stockpiling, health worker accommodations and transportation planning, fiscal considerations and planning for changes in burden of disease are all important issues enhancing event response.

6.5 Natural disasters

Severe natural disasters may poise the greatest disaster threat to peaceful societies. Events like earthquakes, major storms, and flooding can result in near or total societal disfunction. The affect on healthcare can be devastating. Mitigation of risks such as structural enhancement and pre-disaster evacuation, when possible, offer great promise with regard to resiliency. Acceptance of outside recourses, such as search and rescue, medical assistance teams, use of out of system healthcare and public health providers and evacuation teams all represent important response mechanisms.

Examples of support services:

- International search, rescue, and medical services teams
- Humanitarian aid organizations: such as the red cross and red crescent

- FEMA: Training, planning, expertise, logistical, material and financial support
- United States Health department of health and human services: Mobile medical teams (DMAT), healthcare workers supplementation, pharmacy (EPAP) and logistical support.

6.6 War and violent conflict

With its inherent effects on individuals and populations, including trauma, malnutrition, loss of chronic care and increased infectious disease potential, organized violent conflict has the greatest potential impact on population health. Health effects can last long after the conflict is resolved [13]. Mitigation and resilient response are challenging at the level of a hospital or even the broader health system. Reliance on outside resources, evacuation and the greater resources of military institutions may all provide support.

6.7 Pandemic

The COVID-19 pandemic has changed the nature of hospital and healthcare planning and response. While the all-hazards approach is still the dominant paradigm, increased emphasis has been placed on surge capacity, isolation and critical care. Additionally, planning at the regional and or country level has eclipsed planning on the health system and hospital level, apropos of the nature of the event. Another major change is regarding the manufacture and stockpiling of supplies [14]. Those essential for staff and patient safety and barriers to disease spread are no longer subject to just-in-time delivery model shortages.

7. Hospital and healthcare specific security concerns

7.1 Hospitals

Hospitals as soft targets of terrorism and in war is an old phenomenon and one that is guaranteed to continue [15]. This is in part because of the added emotional and psychological importance of healthcare on society as well as the role healthcare facilities play in the broader aspects of social function. Additionally, the nature of healthcare delivery and its increased emotional implications, make it a more potent target for those interested in instilling fear and anger in the population.

7.2 Hospital

Hospital based security. Most hospitals have and should have significant baseline security. Bolstering this in the event of a disaster is key to avoiding violence affecting hospital care and patient's wellbeing.

7.3 Law

Law enforcement. Collaborations with law enforcement to increase supporting during and after a disaster event is also vital. It should be acknowledged that law enforcement priorities during a disaster are many and dynamic. While law

enforcement support for healthcare should be encouraged and planned for, it should be accepted that it is not a guarantee. Additionally, in some circumstances of civil unrest the presence of law enforcement can be divisive.

7.4 Structural

Structural security. 'Lockdown,' a term used to prohibit unauthorized entry and exit from the hospital should be part of disaster planning and drills. Badges should be part and parcel of daily security measures and rigorously enforced during and after a disaster event or in times of high threat. Use of blocked entrances, unauthorized of vehicles close to buildings, controlling of gatherings, screening for weapons and staff drilling for violent events should all be regular security principles employed in healthcare institutions.

8. The role of emergency medicine in disasters

Emergency medicine plays a critical role in disaster response and planning [16]. Understanding and appreciating its role and the importance of emergency medicine leadership in hospital planning are critical to hospital resiliency.

Issues affecting and mechanisms of resiliency regarding emergency medicine include:

8.1 Surge

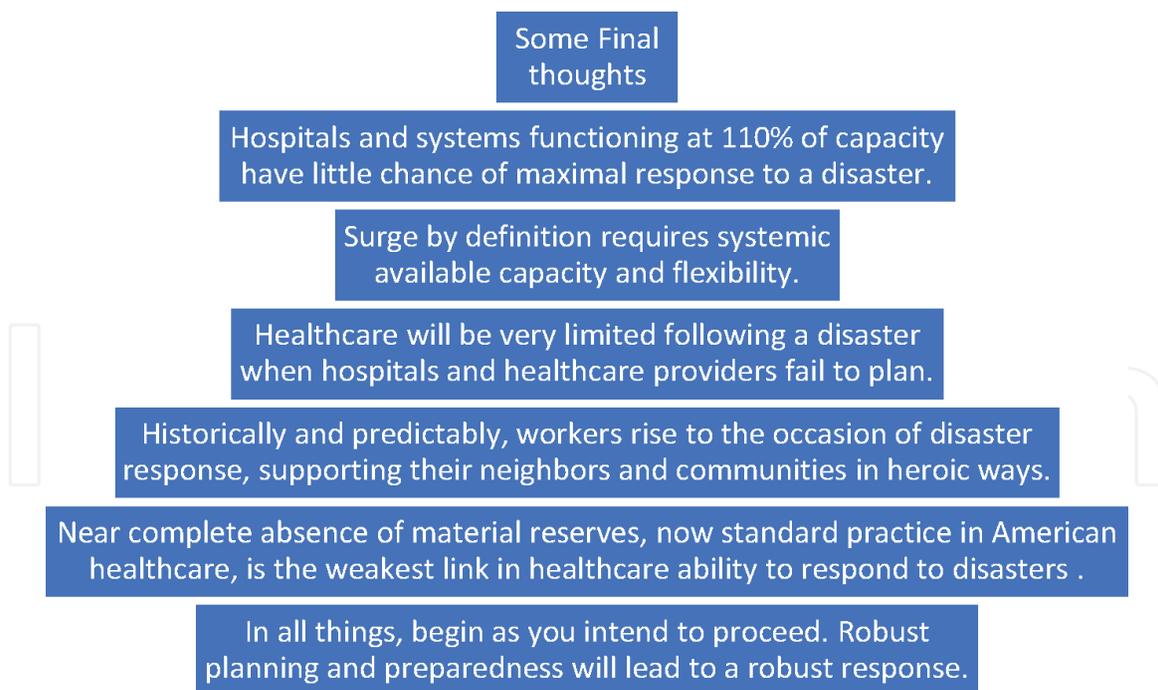
Very few parts of healthcare ever need to undergo clinical surge, whereas in emergency medicine this is common and inevitable. The concept and practice of surge involves a paradigm of, and mechanisms for, flexibility. This impacts all areas of healthcare delivery, such as, the workforce, materials and environmental management and workflow [17].

8.2 Triage

Disaster triage relates not only to the need for choosing where and in what order to care for patients but also the limiting of resources when necessary. With regard to the order and location of care, emergency medicine with its understanding of diverse pathology, familiarity and relationship to other areas of the hospital, and focus on public health, trauma and infectious disease is ideally suited to triage. What is more is that during a disaster triage will become of greater importance as volumes of patients, some with no medical needs overwhelm the system. Limiting of care or Utilitarian theory referred to as 'maximize collective welfare' or to 'do the greatest good for the greatest numbers of people,' is another major component of disaster triage. The principle and practice of Utilitarian theory is part of emergency medicine training [18].

8.3 Access

Access to the health system. The emergency department is the most common way of accessing care in many health systems and it is likely to remain so during a disaster event. Utilizing this tried and established framework, with appropriate augmentation has many practical advantages.



9. Conclusion

Resilient hospital and health system disaster response is dependent on understanding the role hospitals play in disasters, their vulnerabilities and ways to support them. The importance of realizing hospital and health systems changing roles during a disaster, its dependence on other parts of society and perhaps most importantly the challenges faced by its workforce drives disaster planning. Additionally, the threats to hospitals targeted or not, guides planning and response framework. Emergency medicine with its function as the entry way into the health system, understanding of diverse and all encompassing clinical pathology, practice involving surge and triage and its training in disaster medicine gives it a key role in disaster resilience for hospitals and health systems.

Conflict of interest

None.

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